Fig. 1

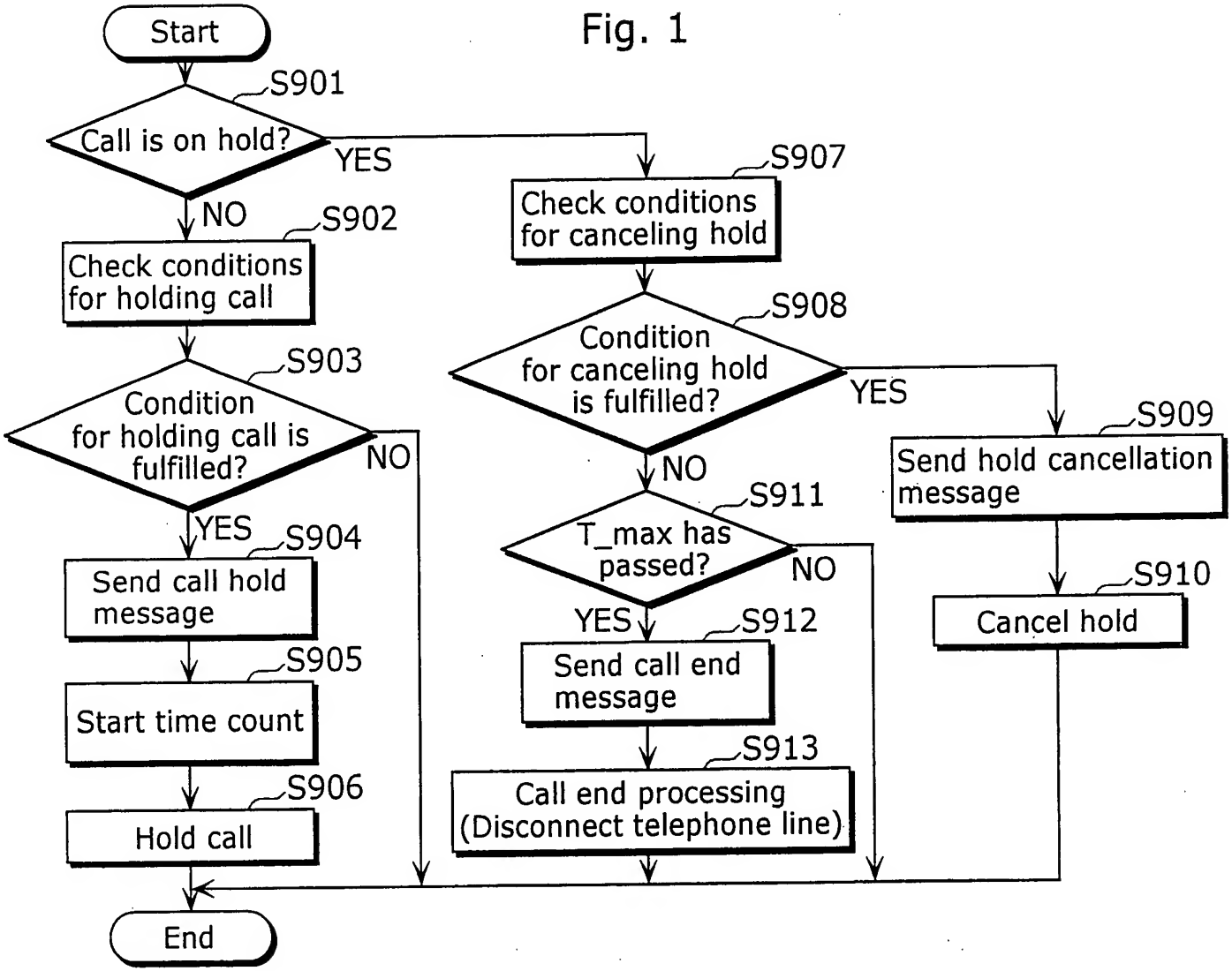

Start
S901
Call is on hold?
YES
NO
S902
Check conditions for holding call
S903
Condition for holding call is fulfilled?
NO
YES
S904
Send call hold message
S905
Start time count
S906
Hold call
End
S907
Check conditions for canceling hold
S908
Condition for canceling hold is fulfilled?
YES
NO
S911
T_max has passed?
NO
YES
S912
Send call end message
S913
Call end processing (Disconnect telephone line)
S909
Send hold cancellation message
S910
Cancel hold

Fig. 2

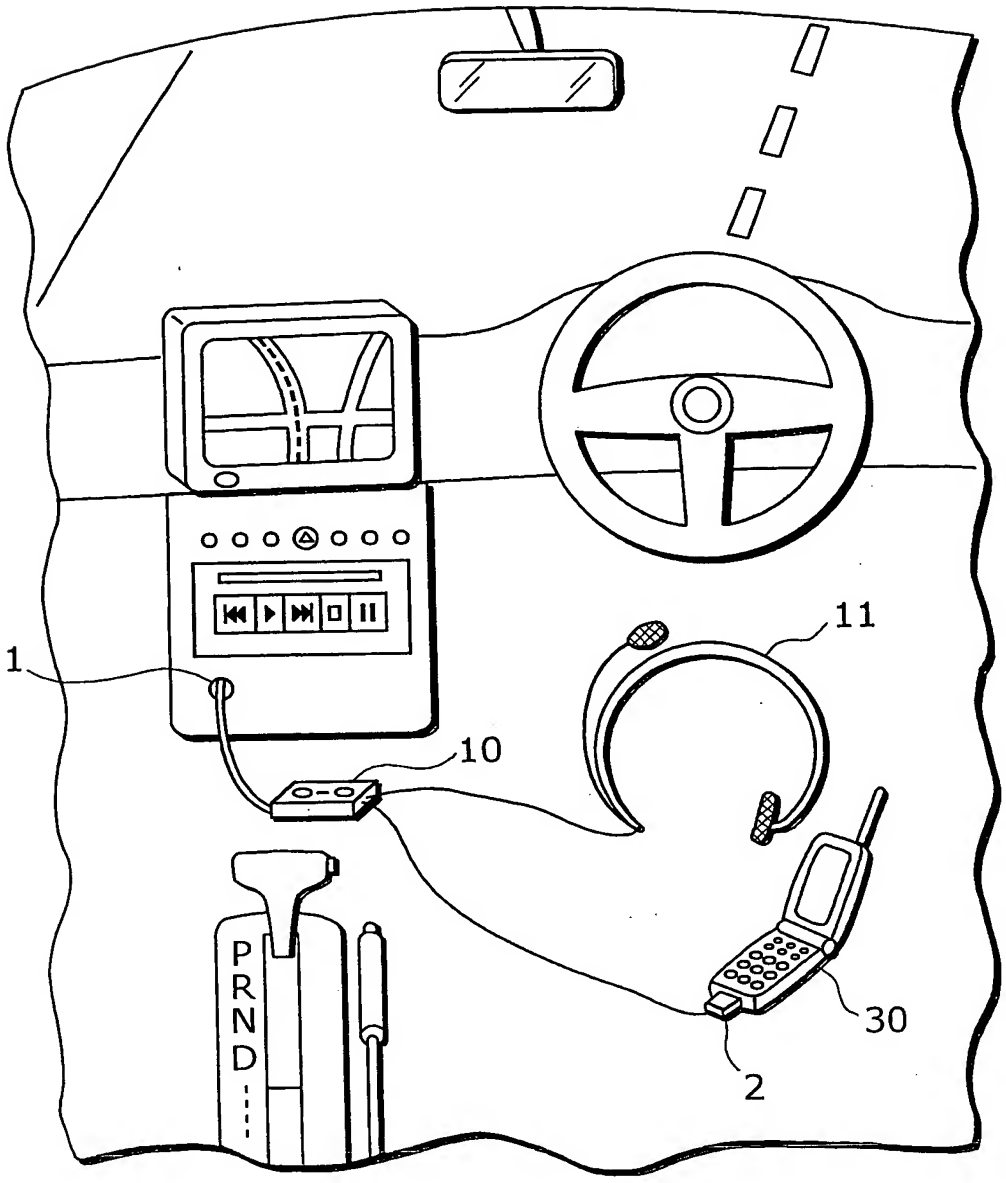


Fig. 3

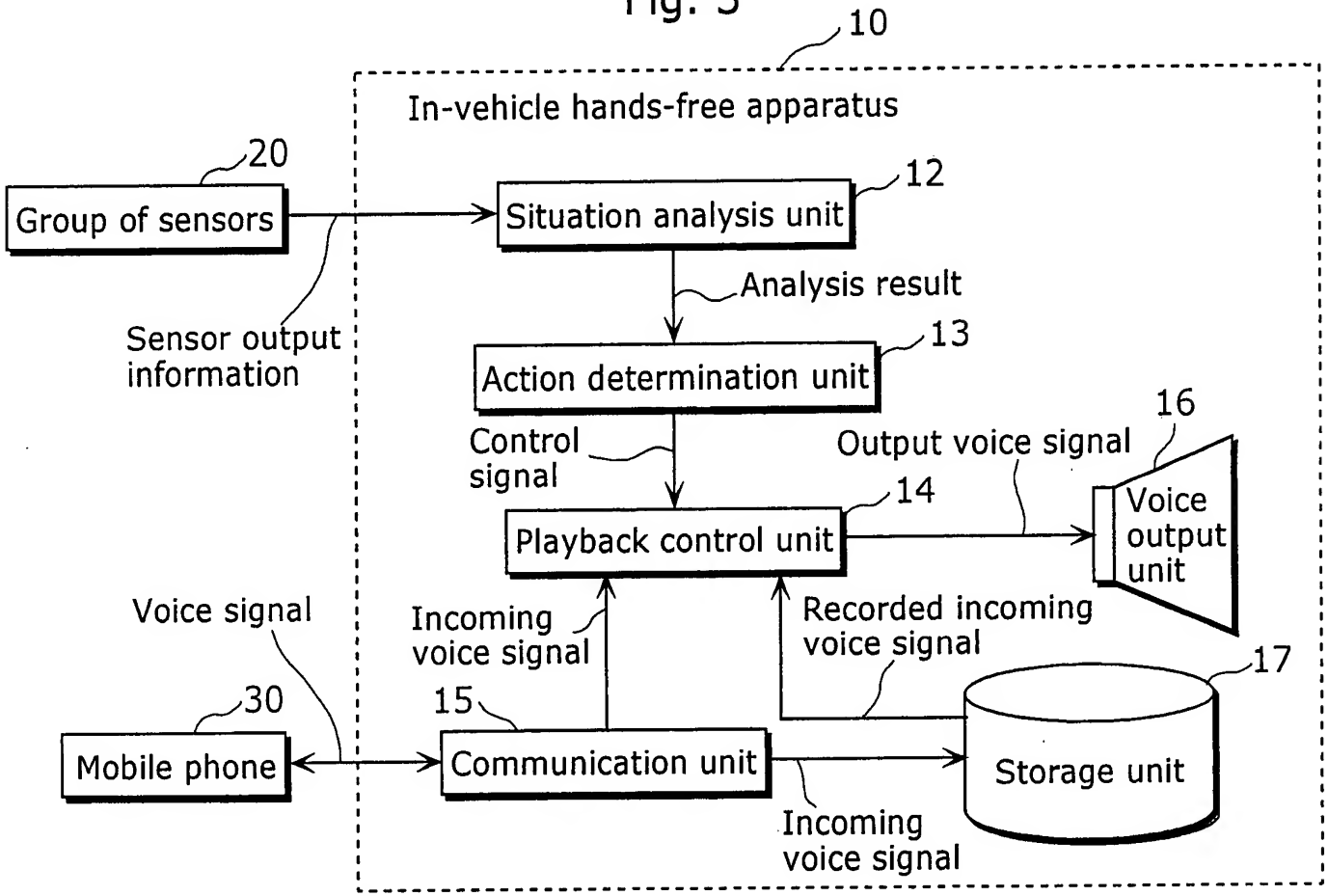

10
In-vehicle hands-free apparatus
20
Group of sensors
12
Situation analysis unit
Analysis result
Sensor output information
13
Action determination unit
16
Control signal
Output voice signal
14
Playback control unit
Voice output unit
Voice signal
Incoming voice signal
Recorded incoming voice signal
17
30
15
Mobile phone
Communication unit
Storage unit
Incoming voice signal

Fig. 4

Sensor Type	Detection	Situation judged from Detection	Situation Category	Determined Action
Winker + Car speed sensor	Winker ON and Car speed	Right or left turn · Merge into main lane · Change lane	Driver's viewpoint moves excessively	Hold a call
Gear	Reverse gear	Move backward		
Winker + Obstacle sensor · Range sensor	Winker ON and Obstacle ahead or behind of car	Start from road shoulder · Stop at road shoulder · Merge into main lane · Change lane		
Obstacle sensor · Range sensor	Obstacle within a predetermined range from car	Obstacle		
Range sensor	Distance between cars within a predetermined range	Short distance between cars	Driver hardly grasps surrounding situation	
GPS terminal	Judged as dangerous terrain based on map data	Complicated and dangerous terrain		
Wiper + Light	Wiper in full swing and Light ON	Low visibility		
Car speed sensor + ETC terminal	Overspeed excessively	Overspeed		
Noise sensor	Noise over a predetermined level	Noise detection	Driver hardly listens to voice	
Acceleration sensor	Sudden slowdown	Driver's danger detection	Driver judges dangerous	
Horn	Horn ON			
Push-button switch	Push-button switch ON			
Emergency notification apparatus (HELP)	HELP activated	Accident	Accident has occurred	
Airbag	Airbag activated			
Each of above devices	Conditions exclusive of above	Non-dangerous situation	Non-dangerous situation	Continue a call · Cancel a hold

Fig. 5

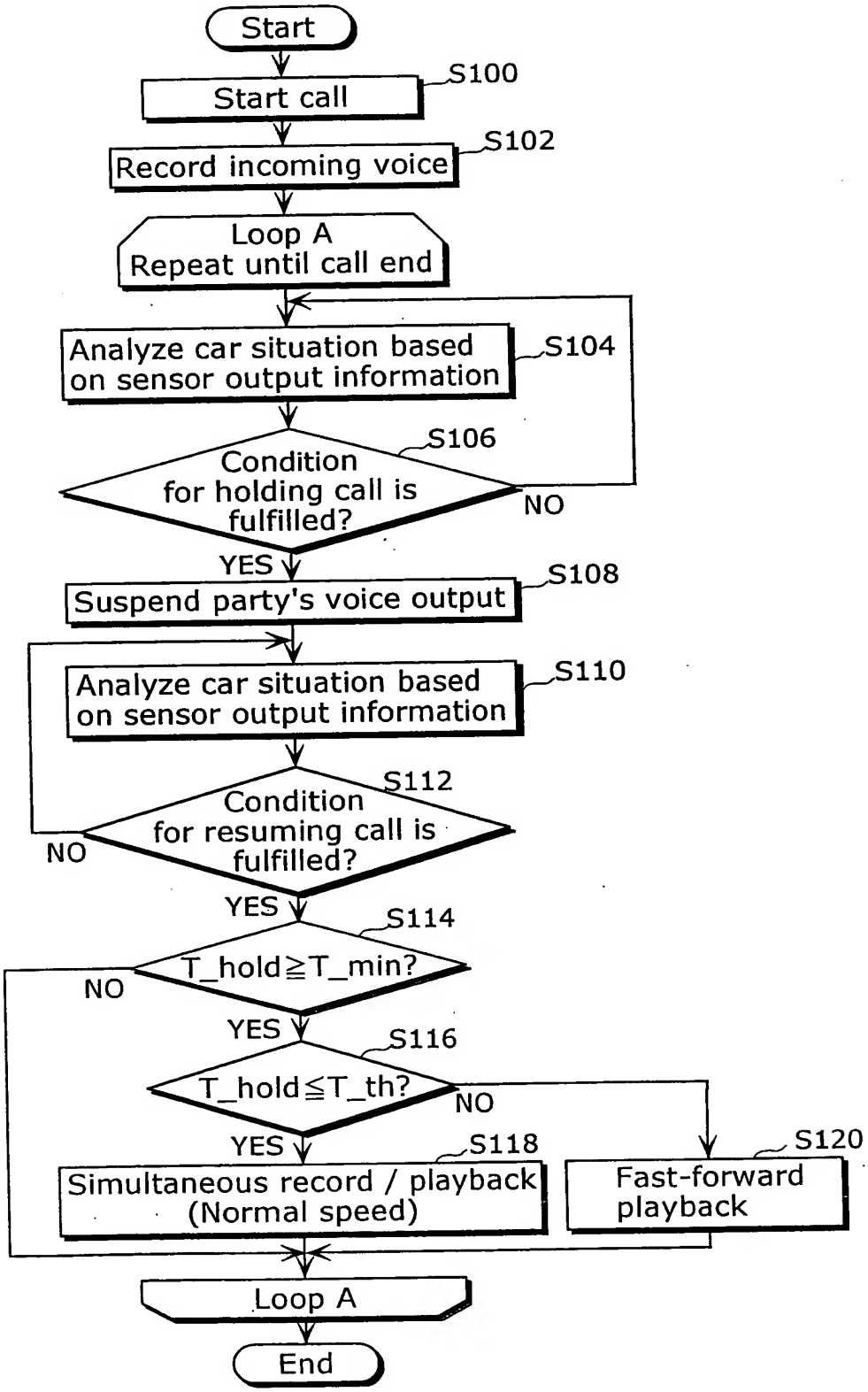

Start
Start call
S100
Record incoming voice
S102
Loop A
Repeat until call end
Analyze car situation based on sensor output information
S104
Condition for holding call is fulfilled?
S106
NO
YES
Suspend party's voice output
S108
Analyze car situation based on sensor output information
S110
Condition for resuming call is fulfilled?
S112
NO
YES
T_hold≧T_min?
S114
NO
YES
T_hold≦T_th?
S116
NO
YES
Simultaneous record / playback (Normal speed)
S118
Fast-forward playback
S120
Loop A
End

Fig. 6

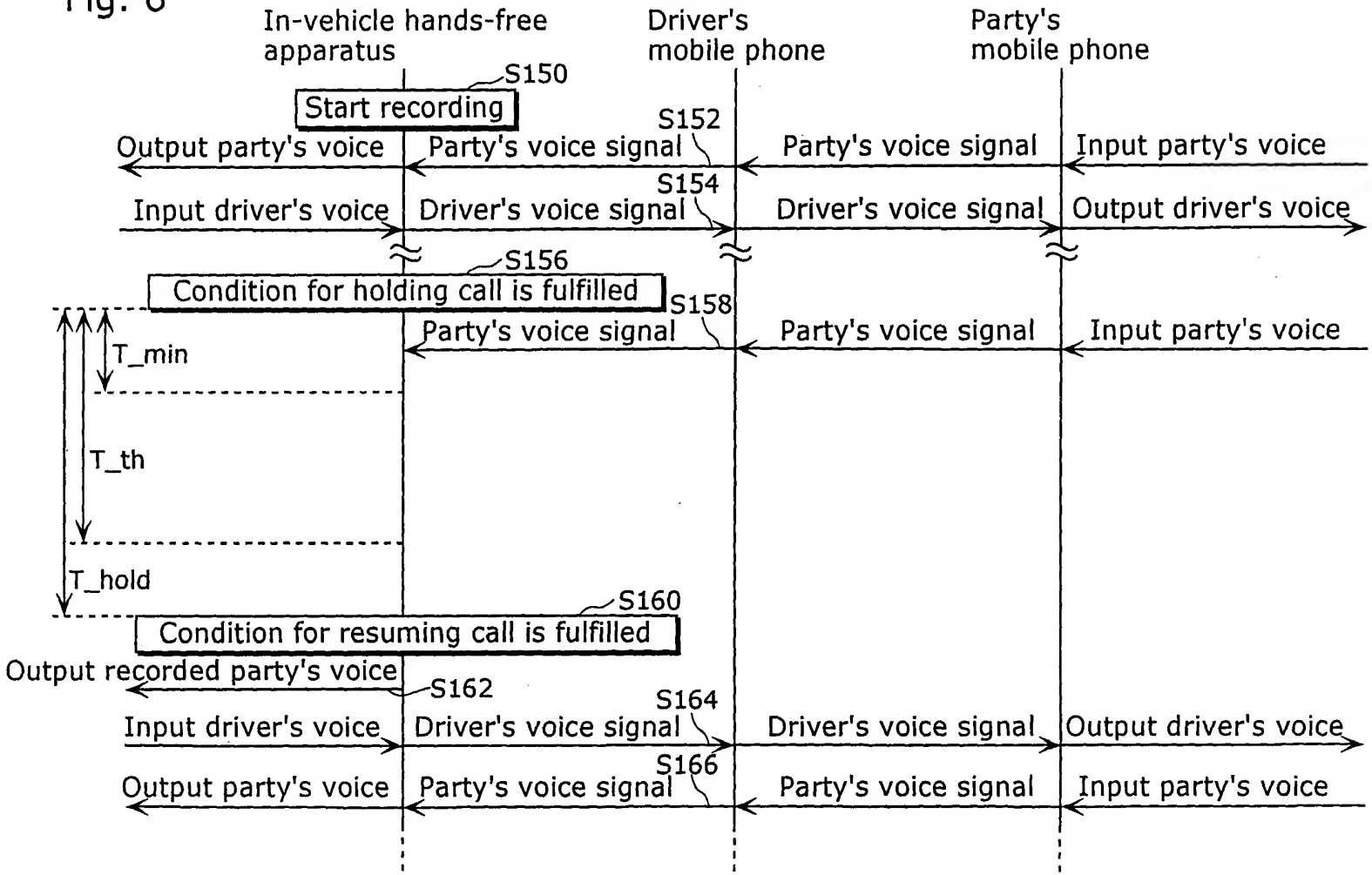

In-vehicle hands-free apparatus
Driver's mobile phone
Party's mobile phone
S150
Start recording
S152
Output party's voice
Party's voice signal
Party's voice signal
Input party's voice
S154
Input driver's voice
Driver's voice signal
Driver's voice signal
Output driver's voice
S156
Condition for holding call is fulfilled
S158
Party's voice signal
Party's voice signal
Input party's voice
T_min
T_th
T_hold
S160
Condition for resuming call is fulfilled
Output recorded party's voice
S162
S164
Input driver's voice
Driver's voice signal
Driver's voice signal
Output driver's voice
S166
Output party's voice
Party's voice signal
Party's voice signal
Input party's voice

Fig. 7

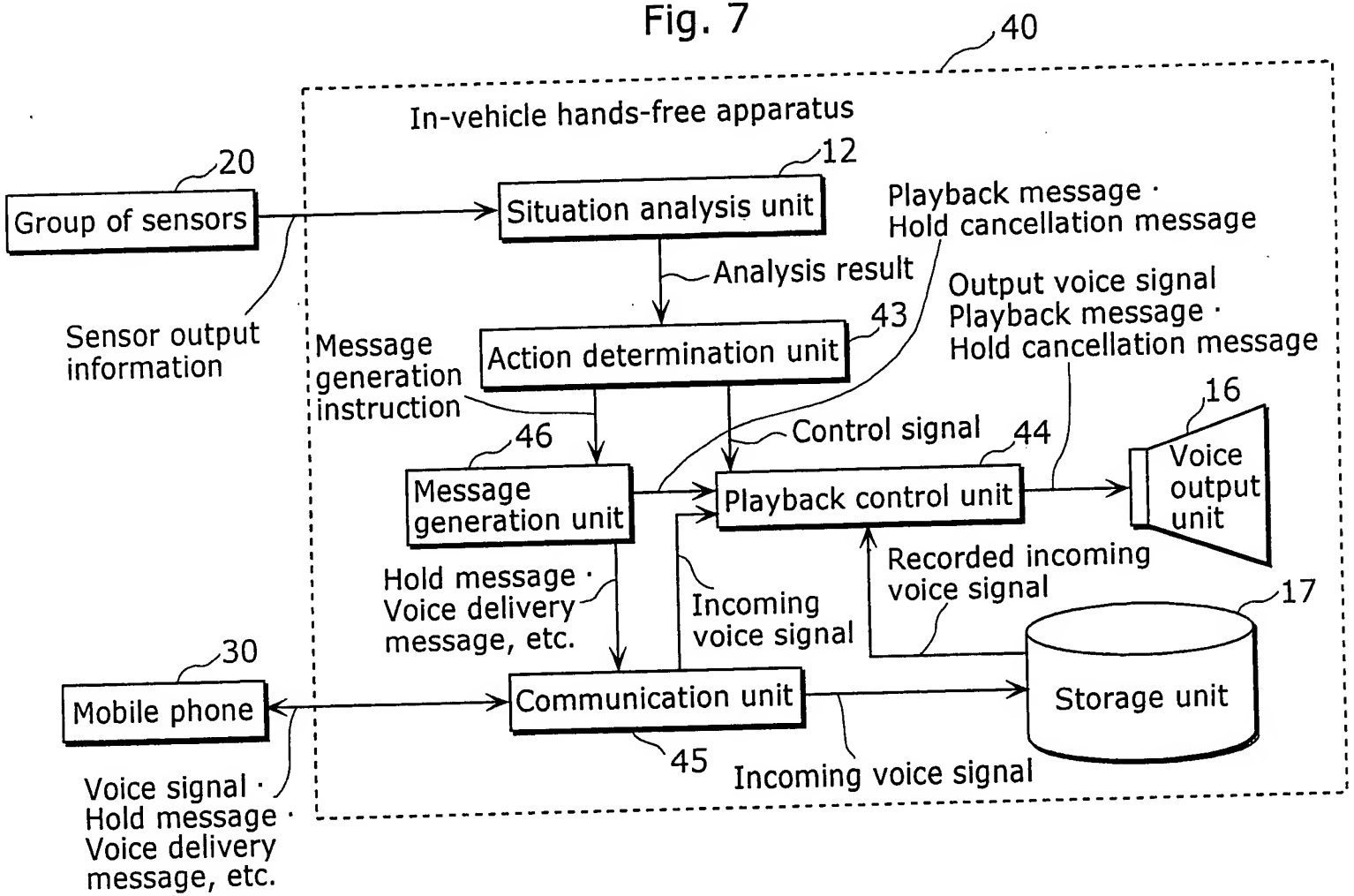

40
In-vehicle hands-free apparatus
20
Group of sensors
12
Situation analysis unit
Playback message ·
Hold cancellation message
Analysis result
Output voice signal
Playback message ·
Hold cancellation message
Sensor output
information
Message
generation
instruction
43
Action determination unit
16
Control signal
44
46
Message
generation unit
Playback control unit
Voice
output
unit
Recorded incoming
voice signal
Hold message ·
Voice delivery
message, etc.
Incoming
voice signal
17
30
Mobile phone
Communication unit
Storage unit
45
Incoming voice signal
Voice signal ·
Hold message ·
Voice delivery
message, etc.

Fig. 8

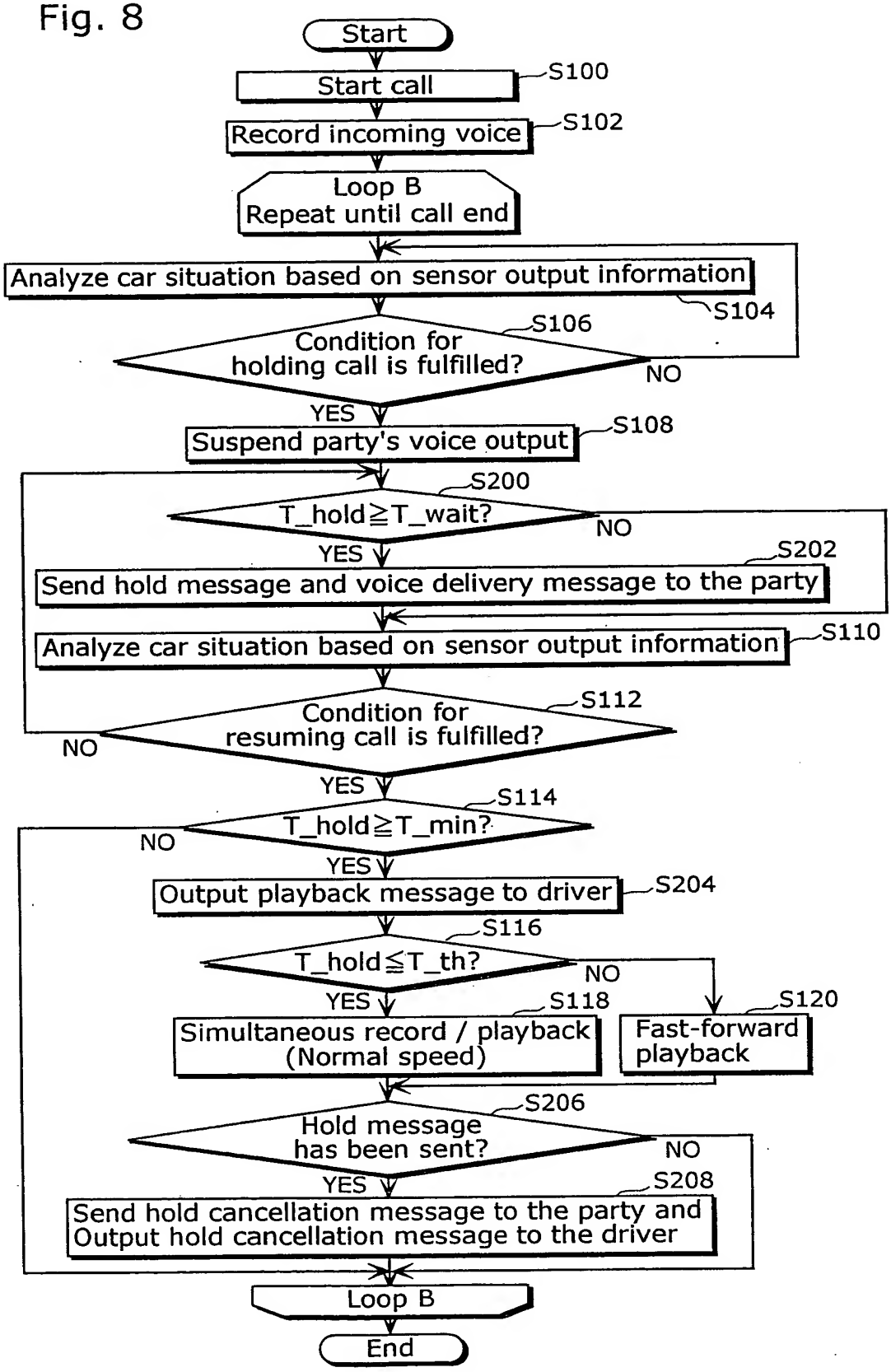
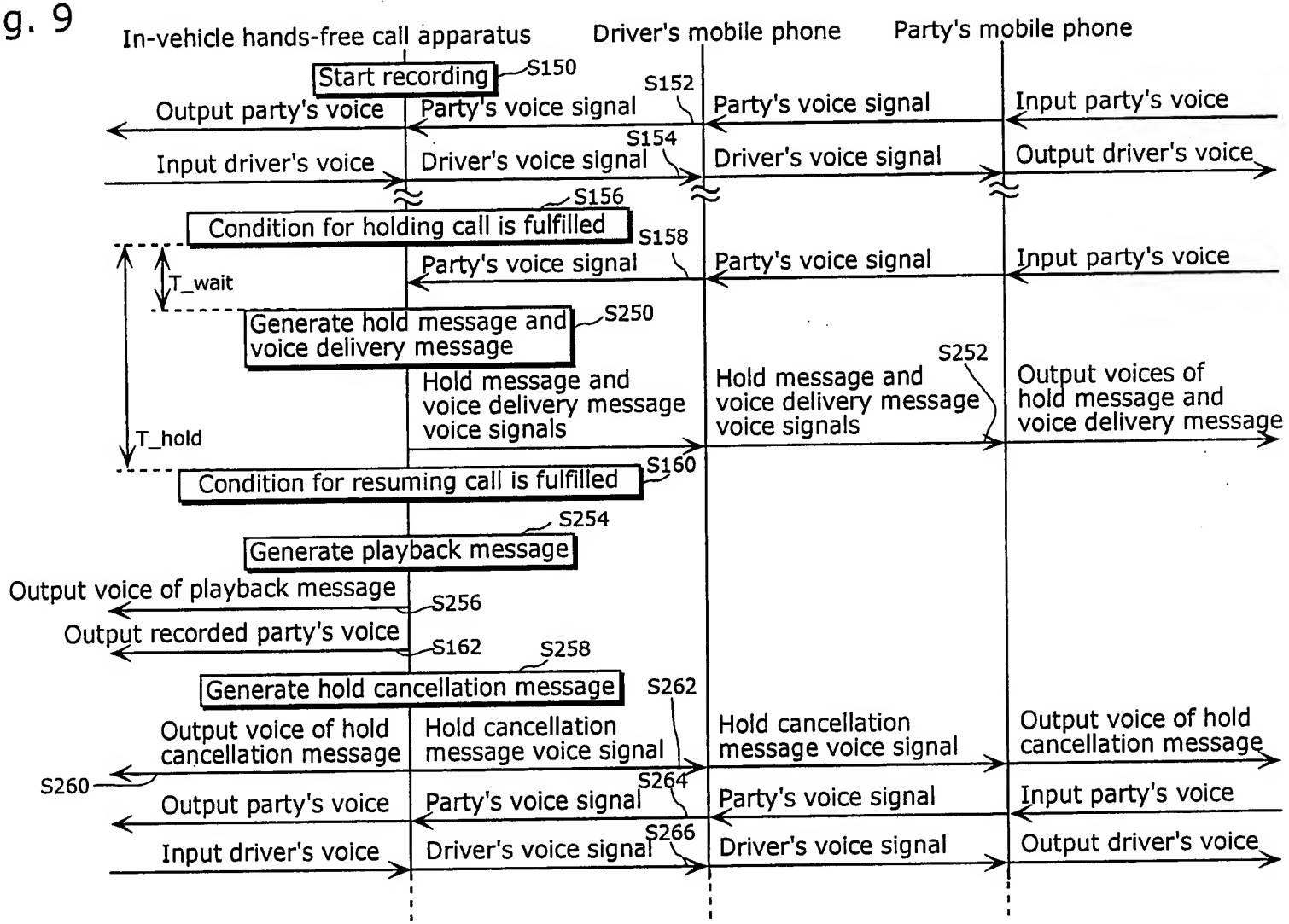

Start
Start call
S100
Record incoming voice
S102
Loop B
Repeat until call end
Analyze car situation based on sensor output information
S104
Condition for holding call is fulfilled?
S106
NO
YES
Suspend party's voice output
S108
S200
T_hold≧T_wait?
NO
YES
S202
Send hold message and voice delivery message to the party
Analyze car situation based on sensor output information
S110
Condition for resuming call is fulfilled?
S112
NO
YES
S114
T_hold≧T_min?
NO
YES
Output playback message to driver
S204
S116
T_hold≦T_th?
NO
YES
S118
Simultaneous record / playback (Normal speed)
S120
Fast-forward playback
S206
Hold message has been sent?
NO
YES
S208
Send hold cancellation message to the party and Output hold cancellation message to the driver
Loop B
End

Fig. 9


In-vehicle hands-free call apparatus
Driver's mobile phone
Party's mobile phone
Start recording
S150
Output party's voice
Party's voice signal
S152
Party's voice signal
Input party's voice
Input driver's voice
Driver's voice signal
S154
Driver's voice signal
Output driver's voice
S156
Condition for holding call is fulfilled
S158
Party's voice signal
Party's voice signal
Input party's voice
T_wait
Generate hold message and voice delivery message
S250
S252
Hold message and voice delivery message voice signals
Hold message and voice delivery message voice signals
Output voices of hold message and voice delivery message
T_hold
Condition for resuming call is fulfilled
S160
S254
Generate playback message
Output voice of playback message
S256
Output recorded party's voice
S162
S258
Generate hold cancellation message
S262
Output voice of hold cancellation message
Hold cancellation message voice signal
Hold cancellation message voice signal
Output voice of hold cancellation message
S260
Output party's voice
Party's voice signal
S264
Party's voice signal
Input party's voice
Input driver's voice
Driver's voice signal
S266
Driver's voice signal
Output driver's voice